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The analysis of the renewable energy production sector in Serbia

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ABSTRACT

Producing energy from renewable sources in Serbia is in its initial phase, and therefore this paper points towards the basic assumptions, potentials and institutional framework for the development of this activity in Serbia. Until recently, production and consumption of energy in Serbia was a social category, but the shift towards market economy together with the fact that Serbia has adopted Kyoto protocol, production of energy from renewable sources became a competitive and obligatory activity. Research shows that the current potentials for producing energy from renewable sources in Serbia are favorable. Besides this, the paper provides an overview of the existing institutional structure in the energy sector in Serbia, but also the short overview of the adequate legal acts. Researches that were done so far have proven that energy potentials of Serbia are insufficiently known and therefore authors will give an overview of the foreign investments in this sector and reveal the possibilities for further investing. Considering the existing know-how base and potentials for the production of equipment, geothermal energy and energy coming from biomass have been identified as priority renewable sources of energy. Producing energy from other renewable sources is also possible, but would require substantial foreign investments. As a final conclusion, the paper states that completely unused potentials for production of energy from renewable sources, together with adequately set institutional framework, would create great possibilities for foreign investments.

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1. Energy sector description

Development of the energy sector is the priority in the process of the development of Serbian economy today [1]. Serbia tries to synchronize its development with the basic assumptions of sustainable development, and based on this, energy sector will be planned and developed as an activity that can have extremely harmful impact on the environment [2]. Strategy for the development of the energy production in Serbia includes primarily initial analysis of the existing conditions in the energy sector and supporting institutions. Serbia is the country that signed Kyoto protocol, it has adequate Energy Law and Sustainable Development Strategy, and as such it has all the preconditions for having legal frame for doing business in Serbia. Besides, authors think that, due to the wish to overview the attractiveness of investing in the energy production from renewable resources in Serbia, one must identify the following:

- Short description and role of the "energy" institutions in Serbia;
- Structure of the RES sector in Serbia;
- Present organization of the sector;
- Investment Programs, Projects and FDI.

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Given elements of the RES sector analysis provide the possibility to comprehend the justification of investing in these activities in Serbia.

2. Present institutional and relational structure in the sector

Production of energy from renewable resources is in its initial phase in Serbia, and therefore it requests adequate approach and strategic planning based on theoretical and practical settings [3]. In line with this, it is necessary to conduct initial analysis of the overall energy sector in Serbia, which means primarily to investigate the conditions within the institutional environment. There are several institutions in Serbia that are active, directly or indirectly, in the process of defining the conditions and rules for doing business in the energy production sector. In most cases, organization, jurisdiction and activity of the institutions are synchronized with the existing institutional framework that already exists in the developed countries.

1. *Ministry of Mining and Energy* is responsible for setting legal framework, approving tariff systems, approving licensing systems, assuring the security of supply, and crisis management in mining and energy sector. This Ministry is responsible for issuing the Energy Approval (over 1 MW). The RES department of the ministry is responsible for bio-fuels (biomass, biodegradable waste, and biogas), small hydropower plants, wind, solar and geothermal energies.
2. *Ministry of Environment and Spatial Planning* is responsible for determining conditions for building objects, approving the building of objects of special importance for the state, determining conditions for protection of the environment through environment impact assessments, setting the rules of sustainable utilization of natural resources and goods, etc. The Ministry is the national centre for Clean Development Mechanism and together with Ministry of Mining and Energy is working on the establishment of Designated National Authority under the Kyoto protocol. The Ministry of Mining and Energy will take the lead in implementation of the projects.
3. *Ministry of Agriculture, Forestry and Water Management* is responsible for agricultural part of bio-fuels and for setting the conditions for water use.
4. *Ministry of Science and Technological Development* is responsible for promoting introduction of innovative technology into the business sector.
5. *Serbian Energy Agency* (*EARS*) is responsible for determining the pricing methodologies and passing the tariff systems for regulated activities, criteria and methods for setting the network connection charges, issuing and revoking licenses and keeping a register of issued and revoked licenses, approving grid codes and market rules, deciding upon lodged appeals, determining the eligibility for the status of eligible customer.
6. *Serbian Energy Efficiency Agency* (*SEEA*) is responsible for setting incentive measures, stimulating rational and efficient energy use and implementation of renewable energy sources exploitation and environmental protection, as well as setting criteria for equipment efficiency evaluation. Its activities also include advisory and educational activities in promoting energy efficiency.
7. *Regional Centers for Energy Efficiency* were established after establishing SEEA in 2002. Supported by Norwegian Government in terms of financial and technical assistances, main objectives of these centers are implementation of the energy policy in the area of energy efficiency, renewable energy sources and environmental protections. There are currently five REEC in Serbia.
8. *Secretariat for Energy and Mineral Materials of the Province of Vojvodina* is responsible for overseeing energy activities in the province, namely, research and development, increase of energy efficiency, introduction of renewable energy, etc.
9. *Environmental Protection Fund* was established in the framework of Law on the Environment Part of the regulatory framework for use of renewable resources does exist, but the laws are not yet fully implemented. The Energy Sector Development Strategy of the Republic of Serbia until 2015 (Strategy) was adopted in May 2005. The Strategy attempts to address current and future problems in the energy sector (GHG emission, energy efficiency, independent and flexible energy systems, with bigger share of RES and decentralized power production) identifying the priority programs, which will contribute to energy sector development, economical development and process of European integrations.

The Strategy targets the increase of RES share in the total energy production from 1.5% (2006) to 4.5% (2010), and decrease of the specific energy consumption for 20% by the 2010.

In 2007, Implementation Program of the Energy Sector Development Strategy for the period from 2007 to 2012 has been adopted. Together with technological modernization and increase of energy efficiency, use of RES is one of the priorities. Serbia, as one of the countries that signed Kyoto protocol, has taken over the responsibility to increase the portion of energy produced from the RES from current 1% up to 20% until 2012, and in this sense, Energy Sector Development Strategy focuses on the set of measures, activities, legal issues, subsidies, and statuses of RES energy producers.

Serbian Energy Law (2004) recognizes the category of Privileged Producers of the electric and/or heating energy. According to the law, privileged producers of electric or heating energy have the right to subventions, custom duties relaxation, and tax reductions, in accordance with the law and other legislation which regulates taxes, custom duties and other taxation, subventions and other incentives. Privileged power producers shall be entitled to subsidies, tax relieves, customs exemptions, and other relieves in line with laws and other regulations on taxes, customs and other duties, such as subsidies and other incentive measures.

3. Structure of the RES sector in Serbia

Renewable energy sector in Serbia is in the process of establishment. Utilization of RES is currently limited to hydropower plants and non-commercial use of biomass and geothermal energy. Hydropower is the only RES utilized for electricity generation and registered in the official Serbian Energy Balance. In light of the existing potentials and expected regulatory changes, other RES will be utilized as well.

According to the data available, total potential of the RES in Serbia (considering only small hydroplants up to 10 MW) is estimated to 3.38 million toes annually (1 toe = 11.64 MWh). Renewable energy potential in Serbia can cover almost half of its primary energy needs. Utilization of these potentials is currently 18%, but it is almost entirely based on production of electricity in large HPPs.

Generally speaking, exploiting the RES energy is insufficient, and therefore existing potentials are absolutely unused. In order to improve the overall situation, Serbian authorities have taken a whole set of measures and activities with the goal to increase the production of energy from RES, based on domestic and foreign investments. Serbia has all the basic potentials for producing energy from RES, but estimations point out the fact that Serbia has the most favorable conditions for usage of geothermal sources, wind, and biomass.

The assessment of the *Biomass* says that there are 2.4 million toes annually (62.7% share in the total RES potential), where 1 million toe represents the wood biomass potential (woodcutting and wood mass refuse produced in its primary and/or industrial processing), and more than 1.4 millions toe consisting of agricultural biomass (agricultural and farming cultivation residues, including also liquid manure). With 55% of its territory being arable land, and 25% under forests, Serbia has high biomass potentials. Northern Serbian province of Vojvodina has the highest potential in agricultural waste, providing 8–12 million tons of biomass annually [4]. Energy potential of biomass is concentrated in the waste from forests and wood processing industry (98% from agriculture, 1.5% from forest production, and 0.5% waste from wood production). The popularity of the use of briquettes and pellets is increasing, similar to other countries with good forest resources. There are several constraints for more widespread use of it for household heating (to replace electricity), including the lack of standards for pellet and briquettes, and low electricity prices. There is no statistical evidence of biomass use in Serbia (usually not reported in energy balance, traditionally utilized for heat generation). Assumption is that the non-commercial biomass share in total primary energy production is about 4–5%, and that non-commercial wood consumption in Serbia lies between 0.46 and 0.54 Mtoe[6]. Biomass is not currently used for electricity generation [5].

Serbia is a country with significant biomass potentials. 29% of the Serbian territory is covered by forests, which represents the huge potential together with the possibilities to produce biomass from the side products of agriculture and animal waste [6]. Energy produced from biomass was used in Serbia traditionally, but sporadically, in an unorganized way, and in the very old fashioned way, technically lagging behind. Therefore, it is necessary to say that investments in the biomass energy is currently most attractive possibility for investors, having in mind that it requires modest investments. The estimation is that usable energy potential of animal waste is about 0.45 Mtoe per year.

During the 1980s, 9 biogas facilities were constructed on large pig and cow farms in Serbia (7 in Vojvodina region), none of which is now operational. The Energy Development Strategy estimates that, by 2015, about 7% of the evaluated 3,183,000 Nm^3/yr could be exploited for electricity generation. The first stage of such program would be the rehabilitation of the six large-scale biogas operations at 6 existing farms. There is 1 primary bio-fuel processing plant in Serbia, built in 2007.

The total technical *hydropower* potential in Serbia is about 17,000 GWh, out of which about 60% is currently utilized. Currently, producing energy from hydropotential is the only way of producing energy from RES that can be measured accurately and that will be recorded in the energy balance sheet of Serbia. Serbia is the country rich in water flows, and the traditional way of getting energy from water is well known here, although not used as much as it should be. The Map No. 1 shows the existing hydropotentials of Serbia (Fig. 1).

The unused potential is situated mainly in the catchments of Drina and Morava rivers and it can be utilized for large as well as for small HPPs. According to the electricity utility company Elektroprivreda Srbije, this potential may be used in 52 large HPPs that would have average capacity of around 25 MW. There are still no final plans for establishing any of the defined large HPPs. The assessment of the technically usable potential of small rivers (facilities for up to 10 MW) is around 0.4 million toe. They represent 10.4% of the total RES potential in Serbia. The hydropower plants for using the potential of small rivers could be classified as follows:

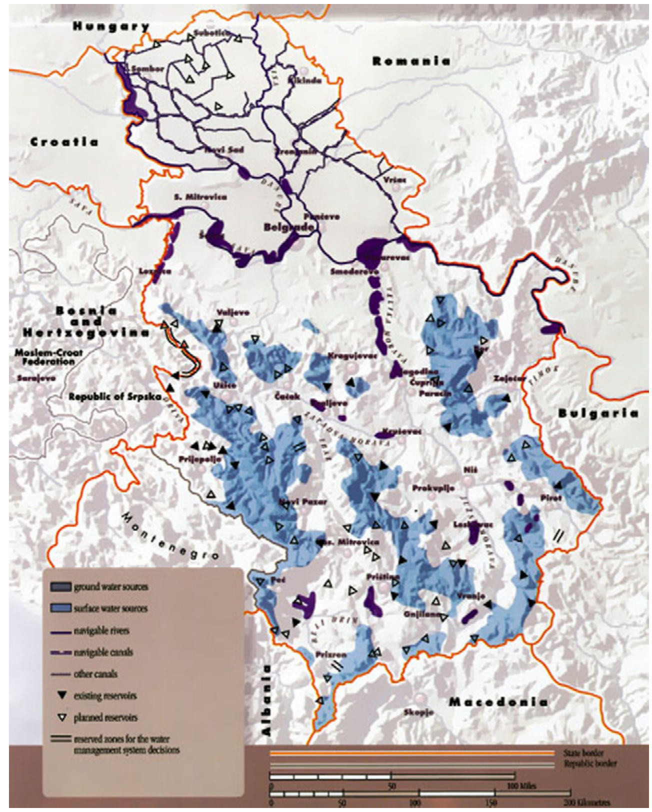


Fig. 1. Map of hydropotential in Serbia.

- Micro-hydropower plants (capacity up to 500 kW).
- Mini-hydropower plants (capacity from 500 to 2000 kW).
- Small hydropower plants (capacity 2000–10,000 kW).

Geothermal energy potential in Serbia is relatively well investigated. Generally speaking, geothermal waters suitable for use are accumulated in all systems. Serbia is very rich with geothermal wells that have been naturally created over centuries, and their distribution is shown in the Map No. 2 (Fig. 2).

Based on the map and current experiences, it can be concluded that Serbia is very suitable place for exploiting geothermal resources, but there are certain limits. Serbia is rich in geothermal wells, but their temperature, profusion, collector properties, chemical composition, gaseous factor and other characteristics are decisive for determining future prospects and particular conditions for exploitation. This is the reason why each drill should be individually investigated in that detail when making decision concerning the choice of exploitation manner and the most suitable equipment.

Research is provided at 73 geothermal drills, deepest was at 2520 m, and shallowest at 305 m. General picture of important and relevant characteristic of geothermal water in Serbia are:

- Drills are mainly self-outflow operated and most frequent water profusion is 10–20 l/s.
- Most frequent outflow temperature is 40–60 °C.
- Geothermal gradients are 4.5–7.5 °C/100 m.
- Nearly all waters contain certain quantities of gases, mostly methane.
- Waters contain dissolved minerals in the range 0.42–13.94 g/l.
- Mineral contents in drills bored for oil and gas are 0.40–40.18 g/l.

Overall heat energy of hydrothermal drills water cooling to 15 °C which included 65 drills was 85,605 kW. Only 23 of them



Fig. 2. Map of geothermal resources in Serbia.

have been triggered for the production of heat energy. Taking into account the tradition in producing energy from this source, Serbia relies on its own scientific and technical potentials when it comes to exploiting water potentials [7,8].

The assessment of the *wind energy* share in the total RES potential is 0.19 millions toe annually (5%). Based on the taken measurements, Serbia has large potential when it comes to production of energy from these sources, which is shown in the Map No. 3 (Fig. 3).

On the Serbian territory, measurements and initial activities related to the construction of wind generators are done by several foreign companies. All the equipment needed for producing energy from this source, as well as the necessary know-how is of foreign origin. Investing in wind energy is currently also completely dependent on the foreign capital.

The assessment of the *solar energy* share in the total RES potential is 0.64 millions toe annually (16.7%), with the planned estimation that every housing unit install approximately 4 m^2, which would represent in total 10.6 million m^2. Although on most of the territory of Serbia the number of sunny days is significantly higher than in many European countries (over 2000 h), because of the high costs of solar radiation collectors and the accompanying equipment, more intensive use of this renewable energy source will depend primarily on the social incentives for the establishment and implementation of the national Renewable Energy Sources Program. Scheme of daily average of global solar energy on horizontal plane in Serbia is given in the Map No. 4 (Fig. 4).

According to the available data, use of solar energy is currently almost negligible. Several examples are solar panels for hot water production in the Special Hospital "Rusanda" in Melenci, a tourism school and two day-care centers in Cacak (donation of Greece). A study for installation of solar panels in Beogradske elektrane (Belgrade municipal heating company)—Cerak, with a capacity of 1.88 MW, is being 45 investigated. Preliminary results show that over €160,000 could be saved per year in natural gas costs, and that the investment would pay off in the 5.6 years.

Production of solar energy, based on the sun potentials in Serbia, can be considered as attractive for potential investors, but it requires significant initial investments, as well as purchasing foreign equipment, which makes it much less attractive compared to production of energy from other RES. Production of energy from RES is one of the most successful ways for Serbia, as well as for other countries who signed it, to comply with Kyoto protocol requests and achieve the adequate stage of sustainable development [9,10].

4. Present organization of the sector

As defined by the Serbian Energy Law, producers who use renewable energy sources or waste in their power generation processes, those who generate electrical energy in power plants considered as small power plants (within the meaning of the Serbian Energy Law), as well as CHP producers that meet energy efficiency criteria, are considered as privileged producers. Procedures for obtaining privileged producer status are partly in place.

The Article 34 of the Energy Law (2004) sets obligations to TSO and DSO to allow access of third parties to the grid. Also, purchase of electricity produced from RES is obligatory.

There are at present 350 potential qualified buyers (21% of Serbia's total electricity consumption), but they continue to purchase their electric power from Electric Power Serbia, which still enjoys a monopoly on both conventional and RES market. Since all HPPs are owned by EPS, this company is the only producer of electricity from RES. Total number of EPS customers is 3.37 million (3.778 at high and medium voltages) Since prices are very low and "privileges" have not been implemented (although

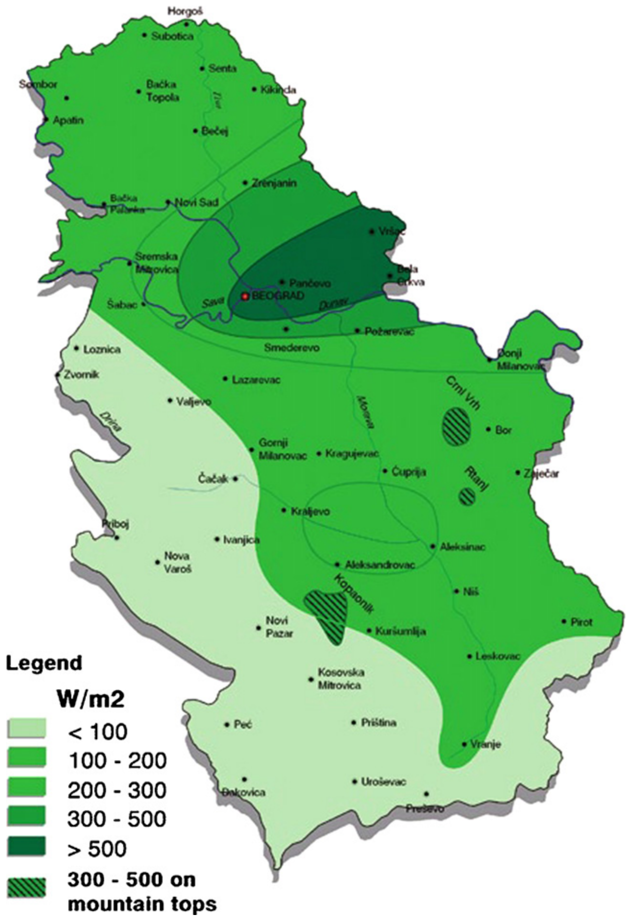


Fig. 3. Map of average wind power at the height of 100 m in Serbia.

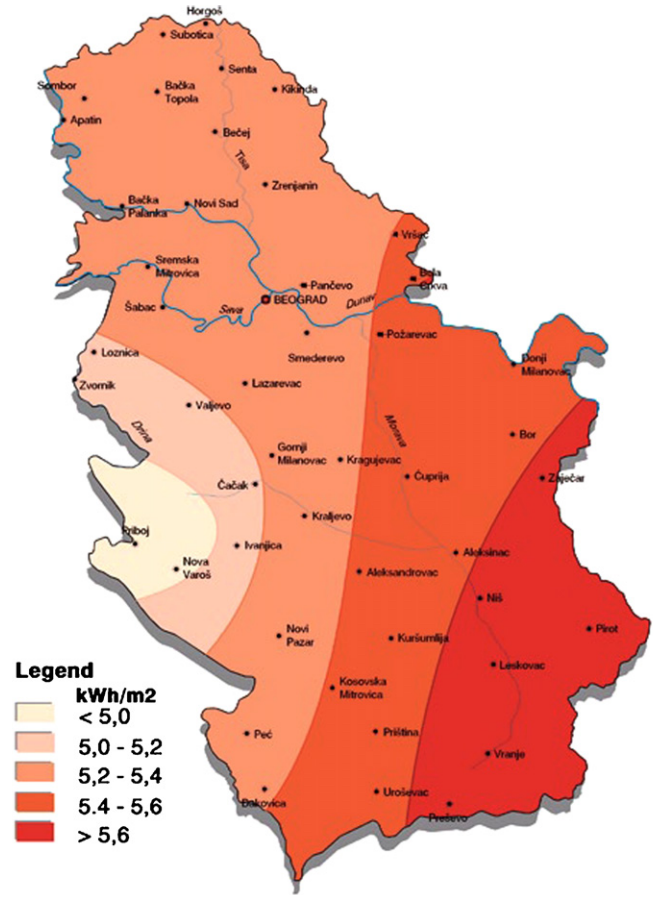


Fig. 4. Map of daily average of global solar energy on horizontal plane in Serbia.

defined in Energy Law), privileged producers cannot compete with EPS, even if they manage to break trough the long list of permits and approvals, and connect to the grid.

With the new legislation that should be in place by mid-2009, this situation is expected to change. According to the recent announcements made by the Ministry of Energy, Electrical Company of Serbia will offer a 12 years contract with guaranteed price of €0.114–0.136 per kWh to all investors who want to produce electricity from RES [11].

5. Investment Programs, Projects and FDI

In order to improve the quality of life and environment protection, in order to put in place the sustainable development concept and respond to Kyoto protocol requirements, Serbia has paid special attention to the development of energy sector. Due to achievement of more successful planning, implementation, and control of the long-term activities in this sector, the government of Serbia has defined certain programs and goals for investments, within the Strategy of Sustainable Development.

Renewable energy source Investments 2007–2012 (*million* €)

Small hydropower plants: 48.8
Boilers on biomass: 16.5
Biogas: 14
Solar energy—installed panel area, m^2: 8.8
Wind energy—installed capacity per year (MW/yr): 28
Geothermal energy—installed capacity per year (MJ/s/yr): 9.2
Expected investments for the period 2007–2012 are prepared in accordance with the expected level of subventions for electrical energy produced in small hydropower plants (2€c/kWh), wind farms (1€c/kWh), and CHP Plants using biogas (3€c/kWh).

A WB study showed that if only 10% use of the available potential (even without wood biomass) was reached by this Program in 2010, annual energy savings would amount to over 0.1 Mtoe, reducing the annual costs of the import of quality energy products by $30 million.

Related to the heating energy production from RES, the assessments are as follows:

- Introduction of heating using biomass in several municipalities, with subventions at the level of 30% of the total investment.
- Use of biomass for the production of energy for self-consumption, in the companies that have the particular biomass residuals.
- Installment of the 8000 m^2 of the solar panels for the hot water production, with subventions at the level of 20% of the total investment.
- Use of the existing geothermal drills, with decreased compensation for the geothermal water exploration as a natural resource.

As said previously, establishing the National Energy Efficiency Fund is also foreseen by the Strategy.

Multilateral/Bilateral Institutions for Support of the Sector

Investing in the production of energy from RES in Serbia is very modest at the moment, and almost all investments are completely implemented by engaging foreign capital. When it comes to projects and investments in this area, the biggest support can be found in bodies, banks, and funds of EU [11].

European Union has strongly supported Serbian energy sector in the previous period. The main EC financial instrument in Serbia was the CARDS program managed by the European Agency for Reconstruction (EAR), providing CARDS program will be replaced by IPA funds when Stabilization and Association Agreement with Serbia comes into force (currently blocked by Dutch vote due to unsatisfactory cooperation with International Criminal Tribunal for former Yugoslavia).

IPA Support will include energy sector restructuring, investment planning, and operation of mandatory institutions to meet the Regional Community Energy treaty and relevant Community legislation, including those concerning the improvements in energy efficiency, energy savings, and the use of RES.

European Agency for Reconstruction has, on behalf of the EU, supported Serbian energy sector with projects totaling €450 million. This has had a major impact leading to record outputs from the power stations, significant reductions in pollution, and much more reliable and stable power supply system.

European Bank for Reconstruction and Development (*EBRD*) funded the single largest investment in RES in Serbia, Victoria Oil (first bio-diesel factory in Serbia), as well as a number of projects in energy and environment sector, including Duboko solid waste land mill, which has plans to develop biogas facility.

EU/EBRD Western Balkan Sustainable Energy Credit Line Facility provides financing for energy efficiency and renewable energy projects through participation of local banks. The EBRD is currently implementing these Facilities in Bulgaria, Ukraine, Slovakia, Romania, Georgia and Kazakhstan. The similar facility is under development in a Serbia as well. ‘‘Seed’’ money for larger EBRD investments is available trough CEI Trust Fund.

EIB (*European Investment Bank*)—Western Balkan Energy Efficiency Fund

European Commission (EC) will give the Grant for Energy Efficiency (EE) investments. All grants available at the EIB are €6 million, which will be allocated across EIB’s clients on a first come first served basis. The grants are given as percentages of EIB Global Loan lending from Financial Intermediaries to End Borrowers.

EU Seventh Framework Program for Research and Technological Development (*FP7*) inherited FP6 that funded several projects related to RES and establishment of SEE Energy Community. It is the EU’s main instrument for funding research in Europe, and it will run from 2007 until 2013. Researchers will help transform the current energy system into a more sustainable one, making it less dependent on imported fuels. The end result will be a diverse mix of energy sources, in particular renewable ones, energy carriers, and non-polluting sources. The budget available for energy is €2.35 billion. Serbia is eligible for FP7 as an associated country. Eligible projects/activities include renewable electricity generation, renewable fuel production, renewables for heating and cooling, energy efficiency and savings, and knowledge for energy policy making.

World Bank (*WB*) has been engaged in a number of projects including Serbia component of the Energy Community of South East Europe Program Project (ECSEE APL3-Serbia) which provides investment support and technical assistance for Serbia and complements donor assistance that creates and develops the capacity of the Transmission, System, and Market Operator and the regulatory agency, all obligations that Serbia has to fulfill under the Athens Memorandum. The project aims to improve electricity market access for consumers and suppliers by increasing the quantity, quality, reliability, safety and efficiency of the bulk power transmission system. The Project consists of two components:

- Component 1: 110 kV Substations and Related Activities for construction of five new 110 kV substations. The construction of these five 110 kV substations will be carried out in two phases;
- Component 2: 110 kV Interconnecting Transmission Lines and Related Activities for construction of new 110 kV interconnecting transmission lines for the substations selected for investment under Component 1 of the project. The construction of these 110 kV interconnecting transmission lines will also be carried out in two phases. In BiH, this project has a direct link with RES, through financing hydropower plants repairs.

Central European Initiative—CEI Special Fund for Climate and Environmental Protection—grants (up to €40,000 per project) for projects in the area of climate and environment protection in the non-EU CEI Member States. Among others, it supports activities conducive to increasing energy efficiency, improving and disseminating environmentally friendly technologies, sanitation of old ecological burdens, and waste management. The eligible projects could take the form of feasibility studies, development plans, expert meetings, know-how transfer, research grants, study tours, training courses, etc.

UN ECE-Financing Energy Efficiency Investment for Climate Change Mitigation Project has recently awarded contract in the amount of US$ 98,8300 to undertake Regional Analysis of Policy Reforms to Promote Energy Efficiency and Renewable Energy Investments. Another project of US$ 1,250,000 will structure and prepare the Investment Fund to reduce greenhouse gas (GHG) emissions in 12 countries of Eastern Europe, South-Eastern Europe (including Croatia, Bosnia and Herzegovina and Serbia) and Central Asia, as well as an analysis of the financial, legal and fiscal issues; solicit public sector entities and private sector investor participation; and prepare the terms of reference for an experienced fund manager. In addition to these, a number of bilateral donors are also present.

Canadian International Development Agency (*CIDA*), which funded SEETEC, a project whose goal is to foster economic growth in South-Eastern Europe by improving management, delivery, and rational use of electricity in the region.

German Kredit fur Wiederafbau (*KfW*) which focuses primarily on the development of the financial sector, improvement of the energy supply, particularly renewable energy and municipal water supply and wastewater treatment.

Spanish Azahar Program which is active in the Clean Development Mechanism (CDM) projects and the development of renewable energies in the Mediterranean Region (Serbia and BiH included). *Austrian Development Agency* whose project includes wind power in Bosnia Herzegovina and bio-fuel and bio-gas in Serbia.

Italian CDM Capacity Building-Related Projects in the Balkans Region which take place in Serbia, Montenegro, Albania and Macedonia. Activities include support for the establishment of the Designated National Authority in Serbia, Montenegro, Albania and Macedonia; and development of the CDM Portfolio for Serbia, Montenegro, Albania and Macedonia.

6. Conclusion

Sector of production of energy from RES in Serbia is in its initial stage. By signing the Kyoto protocol, Serbia has taken over the responsibility to increase the amount of energy produced from RES and natural potential for this is undoubtedly large. All analysis direct to the conclusion that Serbia is specifically suitable for use of the geothermal energy and biomass as renewable sources of energy. Government and all other state level institutions have put the production of energy from RES as the top priority, and there is a special law which regulates adequate subsidies and privileged investment status for the investors in this sector. Energy production sector dealing with RES can be seen as set in order from the legal and institutional point of view, natural resources are significant, so Serbia can expect substantial foreign investments in

this area. Investments that have been done so far are modest, but taking into account decent results, they can be considered as the positive example for all potential investors.

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